DIVERSITY

DIVERSITY IN THE LIVING WORLD

- **Biodiversity** - The diverse form of organisms present on earth is called biodiversity.
- **Taxonomy** – The science of identification, nomenclature and classification of organisms. The word was coined by *AP de Candolle.*
- **Systematics** – Branch of science dealing with taxonomy combined with phylogenetic study (evolutionary relationships). The word was coined by *Carolus Linnaeus* (father of taxonomy).
- **Identification** - Identification is the process of assigning a pre-existing taxon name to an individual organism.
- **Nomenclature** – It is a system of naming of organisms.
- **ICBN** - International Code for Botanical Nomenclature
- **ICZN** - International Code for Zoological Nomenclature
- **Binomial nomenclature** - system of naming organisms by giving each a name composed of two components, generic name and specific name.
- Book written by Linnaeus – *Systema naturae*

Rules for Binomial Nomenclature

- Scientific name usually contains two parts: first word is generic name (epithet) and second word is specific name (epithet).
- Biological names are usually written in Latin (sometimes Greek) and italicized when typed, underlined separately when hand-written.
- Generic name starts with a capital letter while specific name starts with a small letter.
- **Example**: *Mangifera indica* (Mango), *Homo sapiens* (Human), *Oryza sativa* (Rice), *Triticum aestivum* (Wheat)

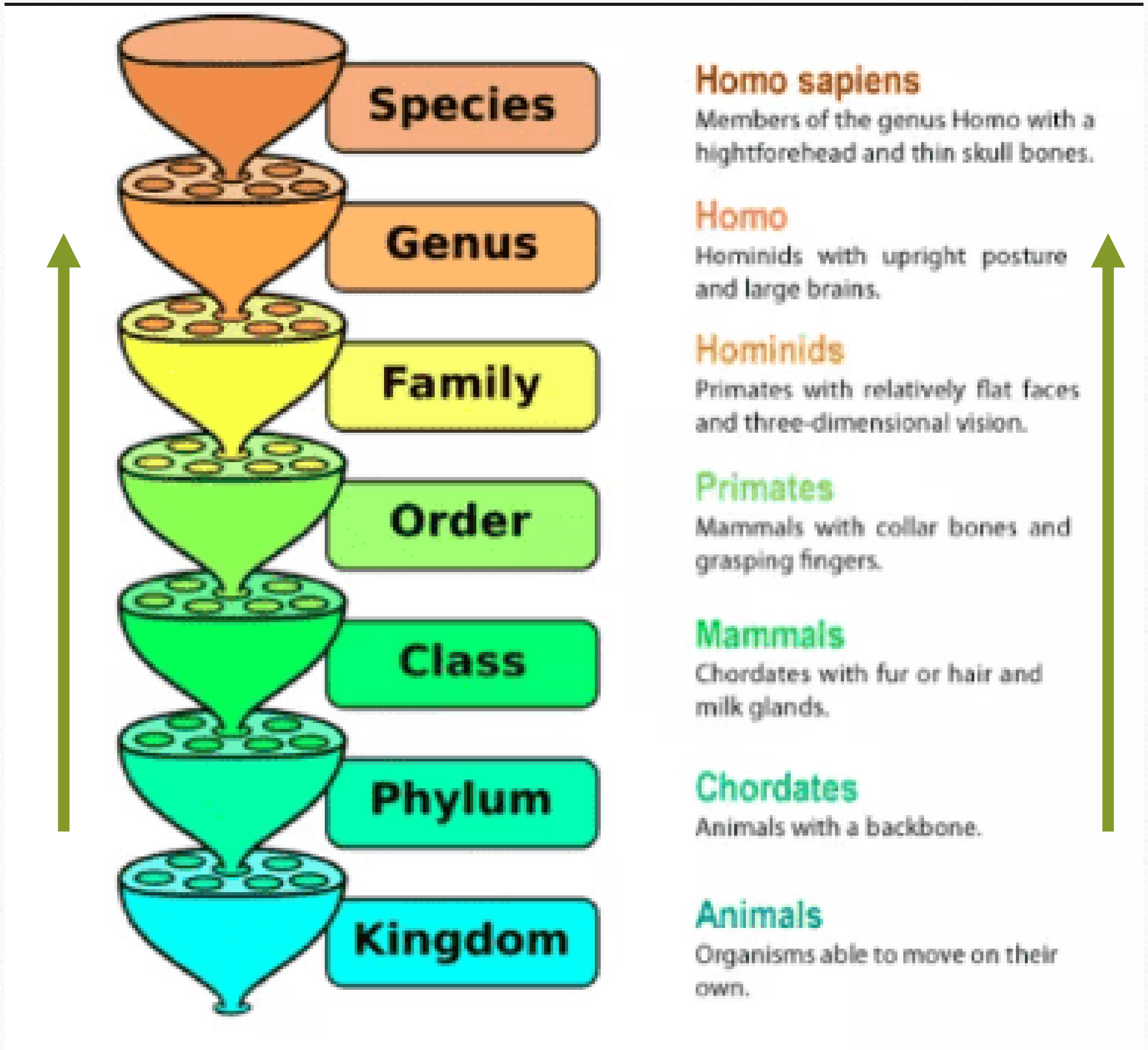
- **Classification** – It is the process of grouping of organisms into categories based on observable characters.
- **Taxon** - The scientific term for any unit used in the science of biological classification.

Linnean Hierarchy

Taxonomic Category – Each level/step in classification hierarchy.

Eg; Genus is a taxonomic category and Homo is a taxon.

Note: Post Linnaeus multiple other levels have been added to this hierarchy, viz., Domain, Sub-phylum, Infra-class, Super order, etc.



Homo sapiens
Members of the genus Homo with a hightforehead and thin skull bones.

Homo
Hominids with upright posture and large brains.

Hominids
Primates with relatively flat faces and three-dimensional vision.

Primates
Mammals with collar bones and grasping fingers.

Mammals
Chordates with fur or hair and milk glands.

Chordates
Animals with a backbone.

Animals
Organisms able to move on their own.

Systematic position
(of humans)

SPECIES

- Species is a group of individuals in which the individuals can naturally interbreed among themselves and produce fertile off-springs.
- Members of a species have a large number of similar characters.
- It is the smallest level of classification.
- Example:- *Mangifera indica* (Mango), *Solanum tuberosum* (potato), *Panthera leo* (lion)

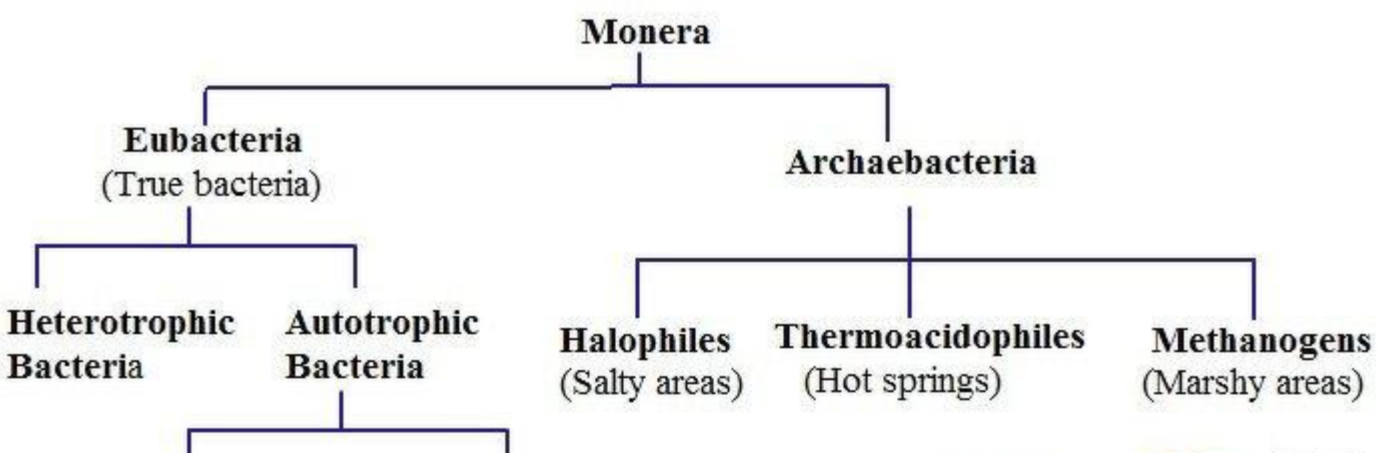
KINGDOM

- A group of all the related phyla (or divisions) is called kingdom.
- Example :
  - The kingdom Plantae comprises all plants from various divisions. These are characterized by eukaryotic organisms, having a cellulosic cell-wall.
  - All heterotrophic, multicellular organisms which are eukaryotic and lack a cell wall are kept under kingdom Animalia.
- Two-three-four-five kingdom classification : Linnaeus (Plantae, Animalia) – Ernst Haeckel (Protista), Copeland (Monera), R.H. Whittaker (Fungi)

Classification of some common organisms

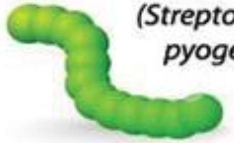
Common Name	Biological Name	Genus	Family	Order	Class	Phylum/ Division	Kingdom
Man	*Homo sapiens*	Homo	Hominidae	Primata	Chordata	Mammalia	Animalia
Housefly	*Musca domestica*	Musca	Muscidae	Diptera	Insecta	Arthropoda	Animalia
Mango	*Mangifera indica*	Mangifera	Anacardiaceae	Sapindales	Dicotyledonae	Angiospermae	Plantae
Wheat	*Triticum aestivum*	Triticum	Poaceae	Poales	Monocotyledonae	Angiospermae	Plantae

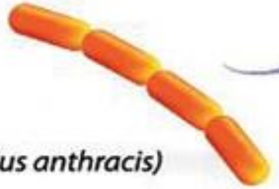
Kingdom Monera



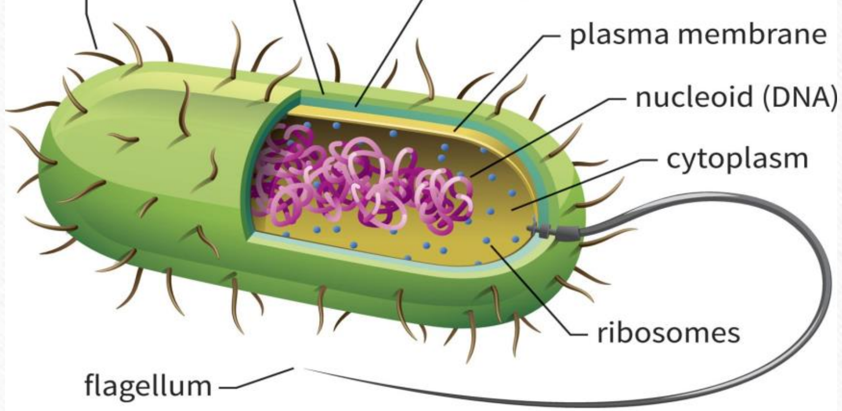
- Classified by **Carl Woese** into two sub-kingdoms (gave 3 domain classification)
- All prokaryotes.
- Cell wall of peptidoglycan (murein) – exception *Mycoplasma*
- Unicellular or colonial

(Streptococcus pneumoniae)


(Streptococcus pyogenes)


(Bacillus anthracis)

(Vibrio cholerae)



(Staphylococcus aureus)

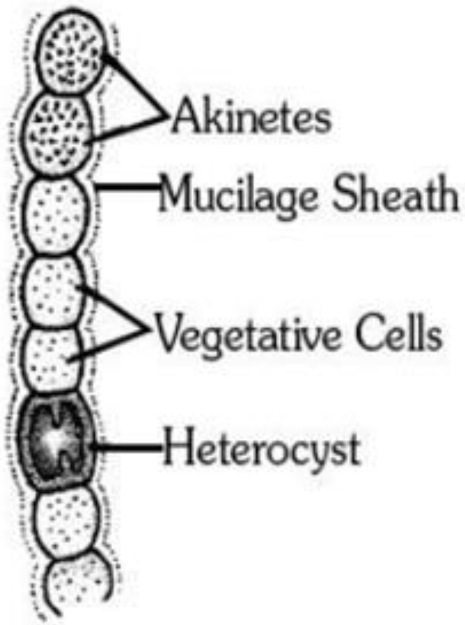
(Sarcina ventriculi)

(Salmonella typhi)

(Helicobacter pylori)

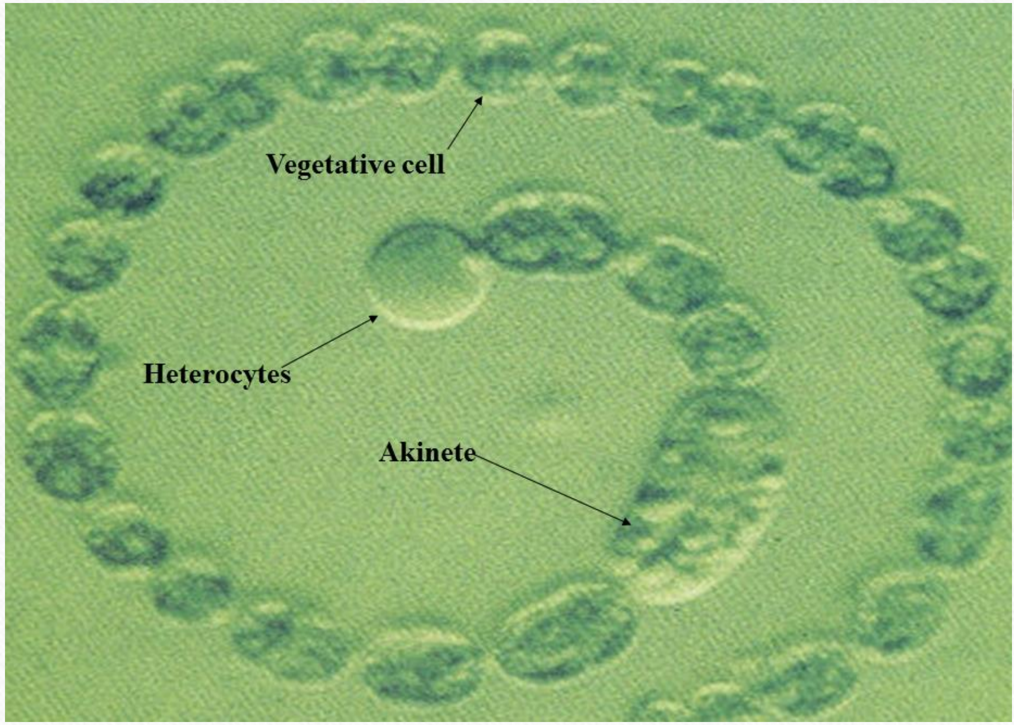
(Clostridium botulinum)

(Treponema pallidum)



ANABAENA (BGA)

- Photosynthetic BGA have chlorophyll a (like plants), whereas other photosynthetic bacteria have bacterio-chlorophyll.
- Bacteria reproduce by fission or by spore formation.
- Some are nitrogen-fixing – have specialized cell - *heterocyst*
- Some are pathogenic

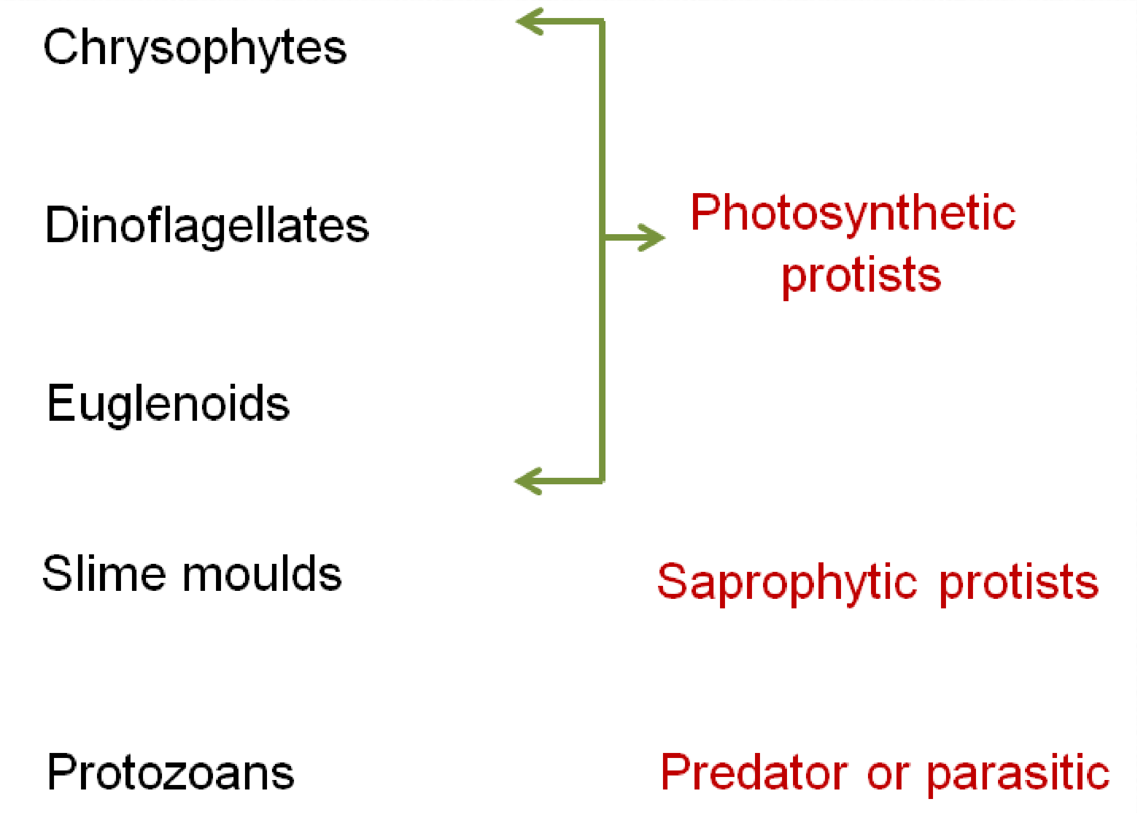


Kingdom Protista

- All unicellular eukaryotes – Junkyard
- Flagella/Cilia/Pseudopodia for locomotion.
- Some forms are planktonic.
- Reproduce sexually or asexually.
- *Divisions*

Chrysophyta

- Includes diatoms and desmids (golden algae)
- Aquatic planktons (phytoplankton)
- Diatoms have siliceous frustule, having overlapping theca.
- On death of diatom the frustules settle at the bottom of the water body to form diatomaceous earth.



Chrysophytes

Dinoflagellates

Euglenoids

Photosynthetic protists

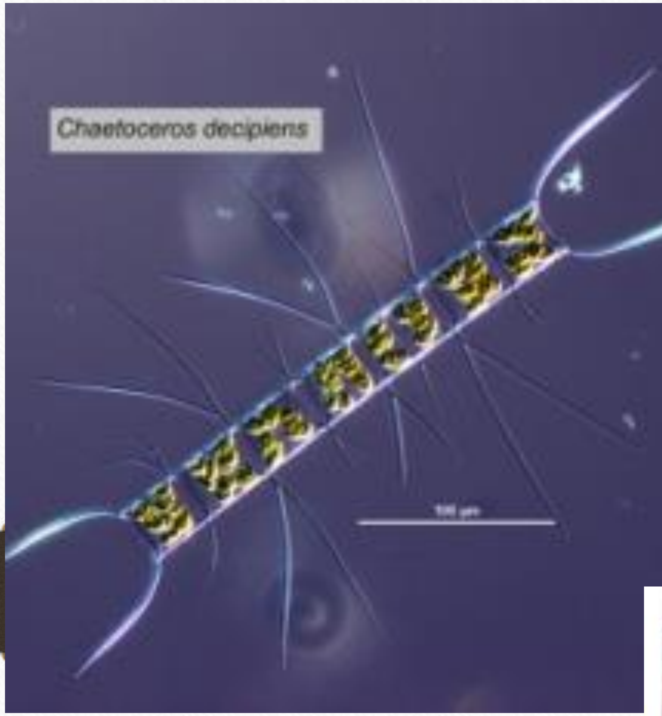
Slime moulds

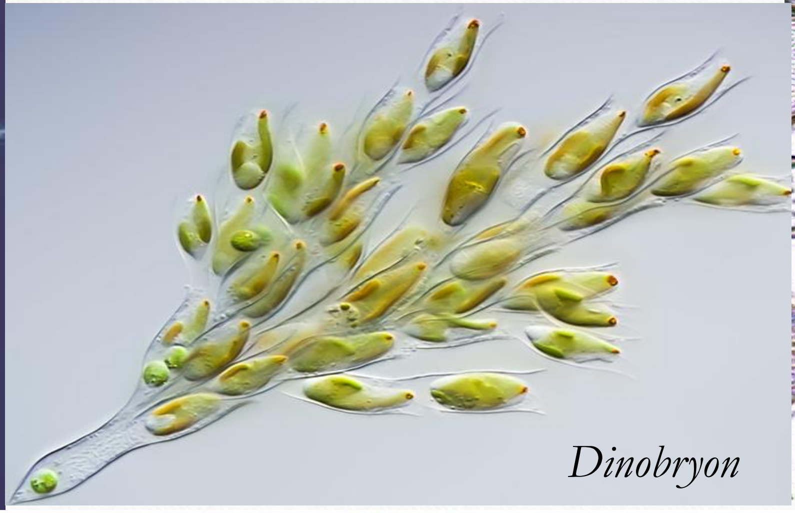
Saprophytic protists

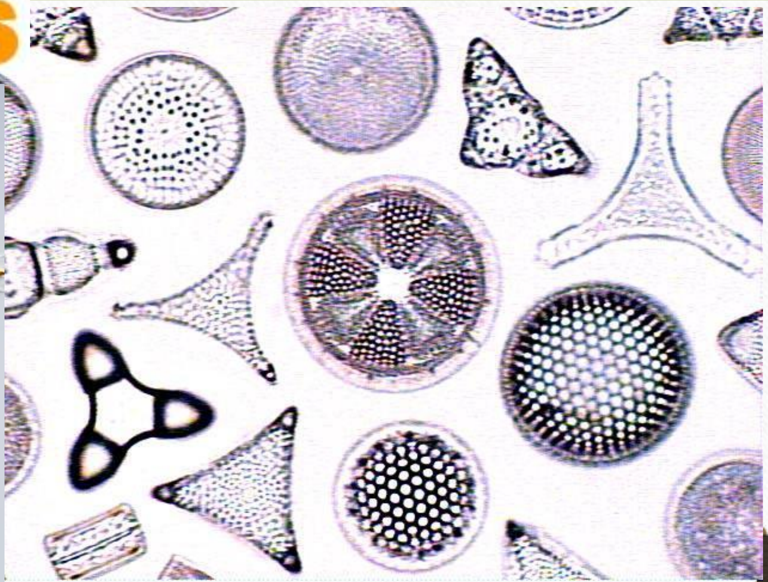
Protozoans

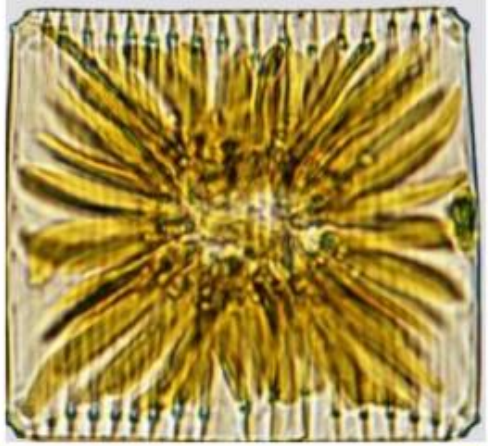
Predator or parasitic

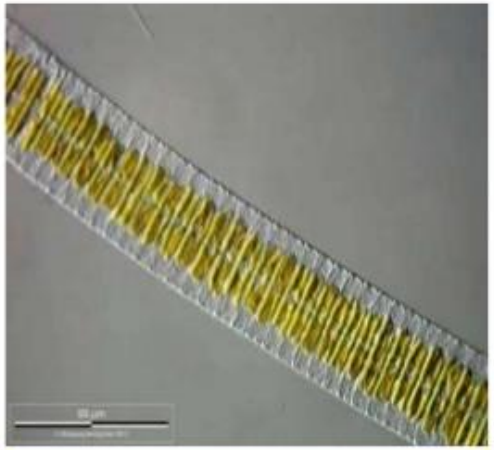
EXAMPLES OF CHRYSOPYTHES




Dinobryon

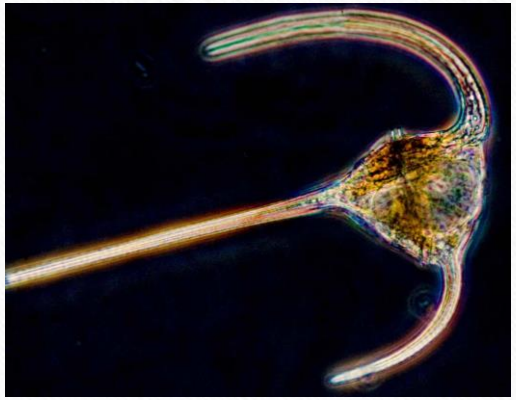


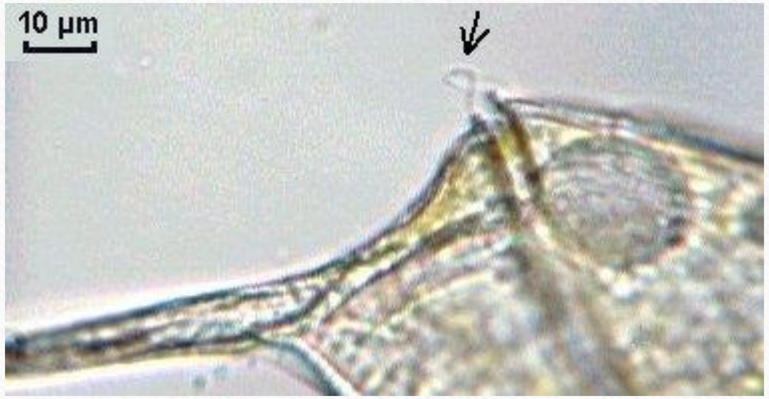

STRIATELLA


FRAGILARIA

Dinoflagellata

- Have two flagella (perpendicular to each other)
- Aquatic planktons
- Mostly autotrophic
- Stiff cellulose plates
- Causes red tides (*Karenia, Gonyaulax*).
- Shows bioluminescence (*Noctiluca, Gonyaulax*).





Euglenoidea

- Have two flagella, anteriorly.
- Aquatic planktons
- Mostly autotrophic (heterotrophic in absence of light – mixotrophic)
- Protein coat – pellicle
- Divide by longitudinal fission.

Euglena

Eutreptia

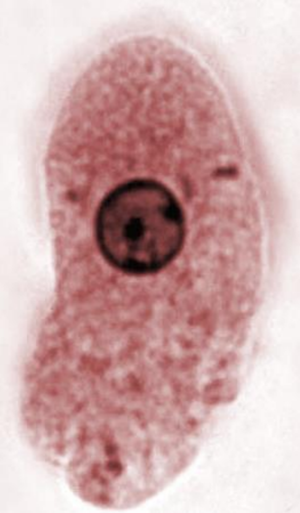
Slime moulds

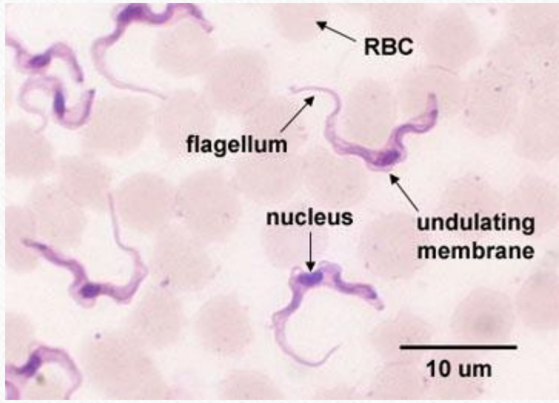
- Saprophytic phagocytes
- Colonial, may form plasmodium (by fusion of multiple cells to resemble a multinucleated cell)
- Lack cell wall
- Amoeboid
- Considered to be ancestors of fungi
- Eg; *Fuligo septica*

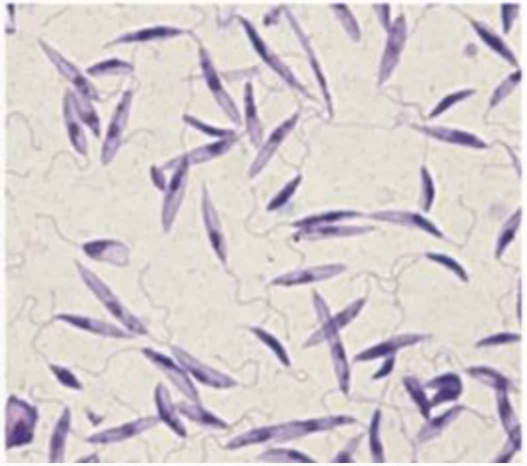
Physarum

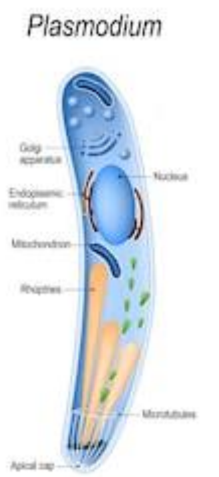
Protozoa

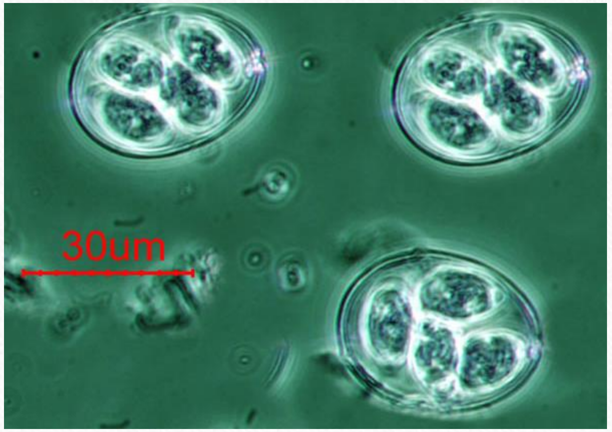
- Heterotrophs
- Lack cell wall
- Considered to be ancestors of animals
- *Types*
  - **Amoeboids** : Form pseudopodia.
  - **Flagellates** : Eg: *Trypanosoma, Leishmania*
  - **Ciliates** : *Paramoecium, Vorticella, Balantidium*
  - **Sporozoans** : *Plasmodium, Eimeria*





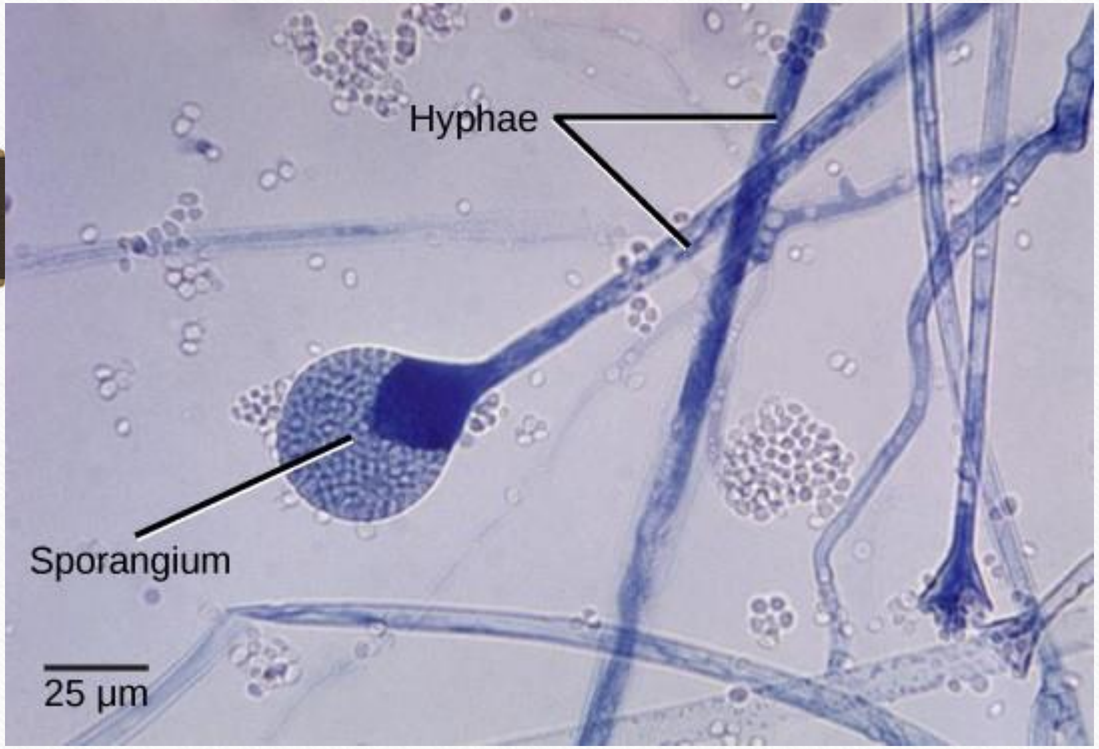


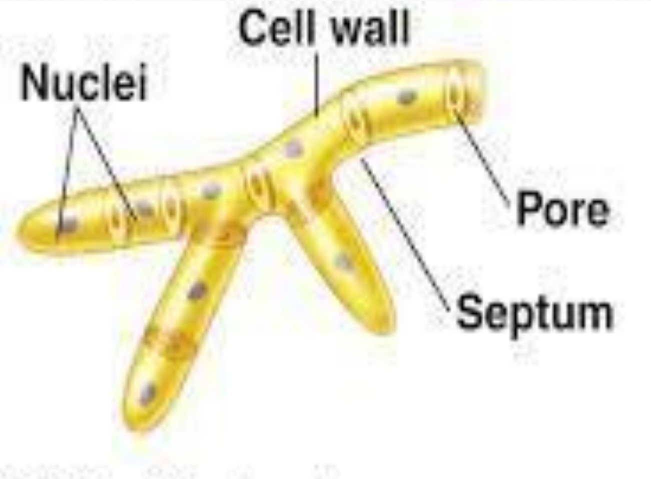




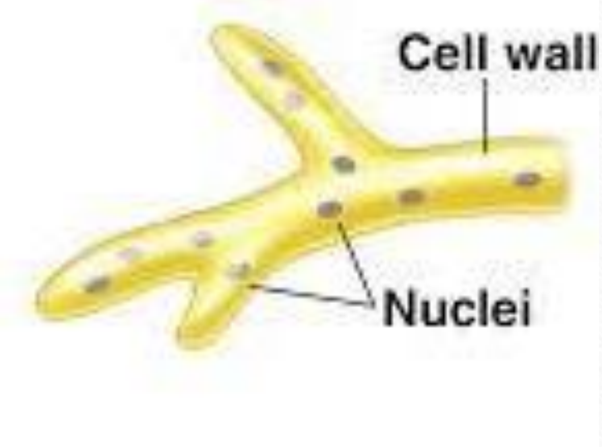
Kingdom Fungi

- Heterotrophs (saprophyte or parasite), some symbiotic (lichen mycobiont, mycorrhiza)
- Some pathogenic
- Multicellular (Exception ?)
- Chitinous cell wall
- Reproduction asexual (budding, fragmentation, spore formation) or sexual.
- Body mycelium, made up of multiple interlinked hyphae (sing. hypha)

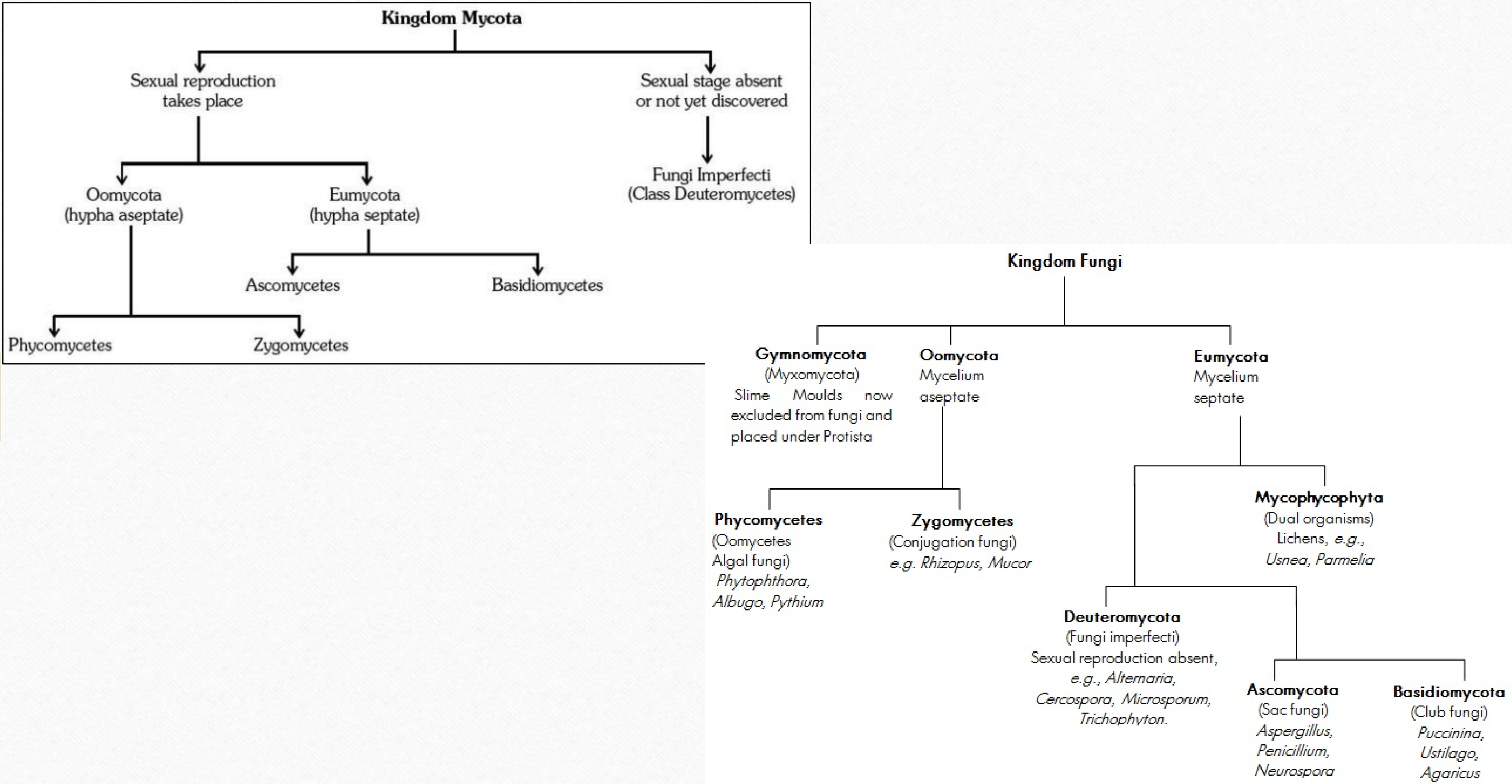




(a) Septate hypha



(b) Coenocytic hypha



Kingdom Mycota

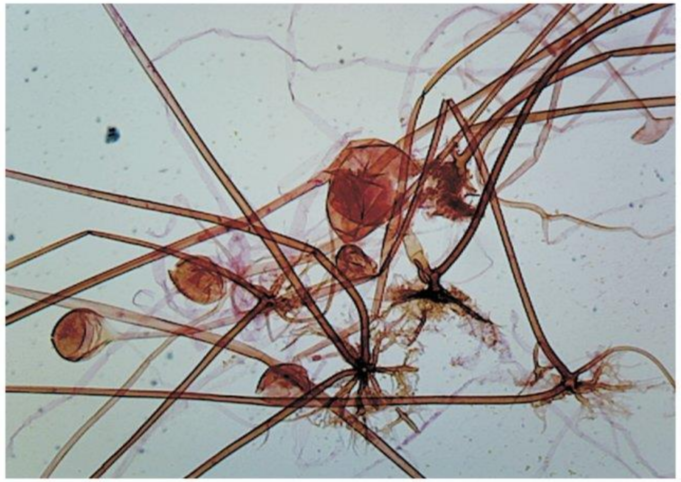
- Sexual reproduction takes place
  - Oomycota (hypha aseptate)
    - Phycomycetes
    - Zygomycetes
  - Eumycota (hypha septate)
    - Ascomycetes
    - Basidiomycetes
- Sexual stage absent or not yet discovered
  - Fungi Imperfecti (Class Deuteromycetes)

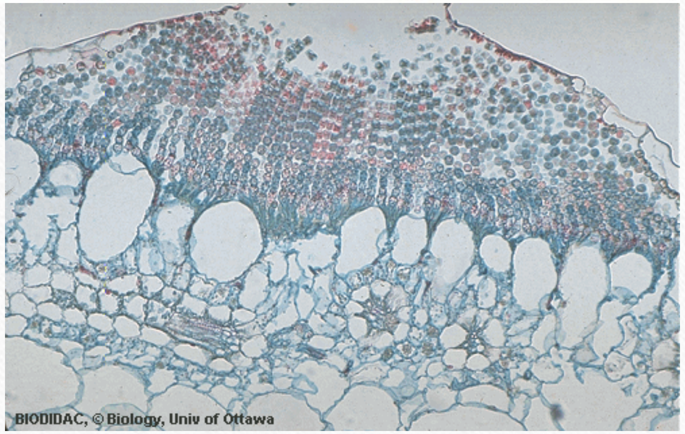
Kingdom Fungi

- **Gymnomycota** (Myxomycota) Slime Moulds now excluded from fungi and placed under Protista
- **Oomycota** Mycelium aseptate
  - **Phycomycetes** (Oomycetes Algal fungi) *Phytophthora, Albugo, Pythium*
  - **Zygomycetes** (Conjugation fungi) *e.g. Rhizopus, Mucor*
- **Eumycota** Mycelium septate
  - **Mycophycophyta** (Dual organisms) Lichens, *e.g., Usnea, Parmelia*
  - **Deuteromycota** (Fungi imperfecti) Sexual reproduction absent, *e.g., Alternaria, Cercospora, Microsporum, Trichophyton.*
  - **Ascomycota** (Sac fungi) *Aspergillus, Penicillium, Neurospora*
  - **Basidiomycota** (Club fungi) *Puccinina, Ustilago, Agaricus*

Phycomycetes

- Found in aquatic or moist habitats, or as obligate plant parasites.
- Mycelium aseptate, coenocytic.
- Asexual reproduction by endogenously formed spores.
- Eg: *Mucor, Rhizopus, Albugo*





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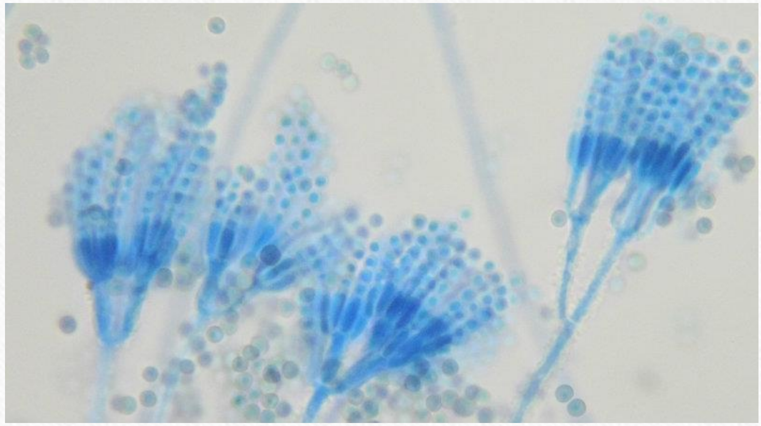
Ascomycetes

- Sac fungi
- Mycelium branched, septate.
- Asexual reproduction by exogenously formed spores.
- Eg: *Penicillium, Aspergillus, Neurospora,* yeast, morels, truffles.

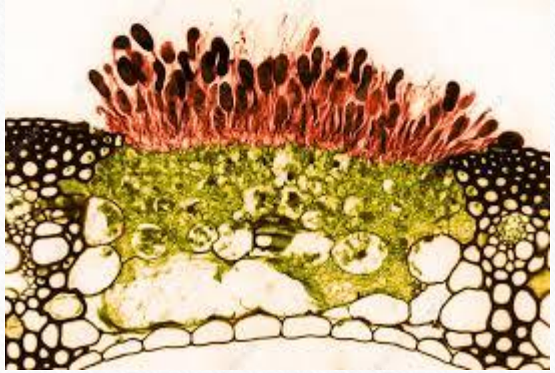


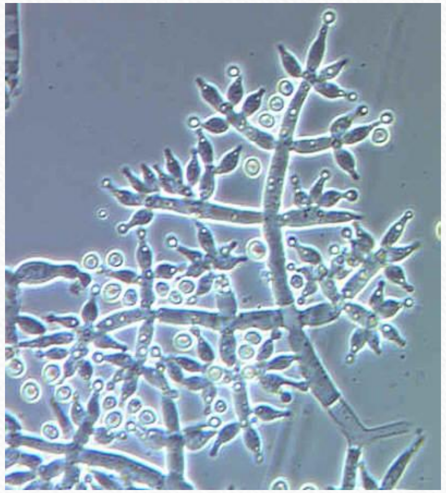
Basidiomycetes

- Mycelium branched, septate.
- Asexual reproduction mostly by fragmentation, sometimes by exogenous spores.
- Eg: Mushroom (*Agaricus*), *Ustilago, Puccinia*

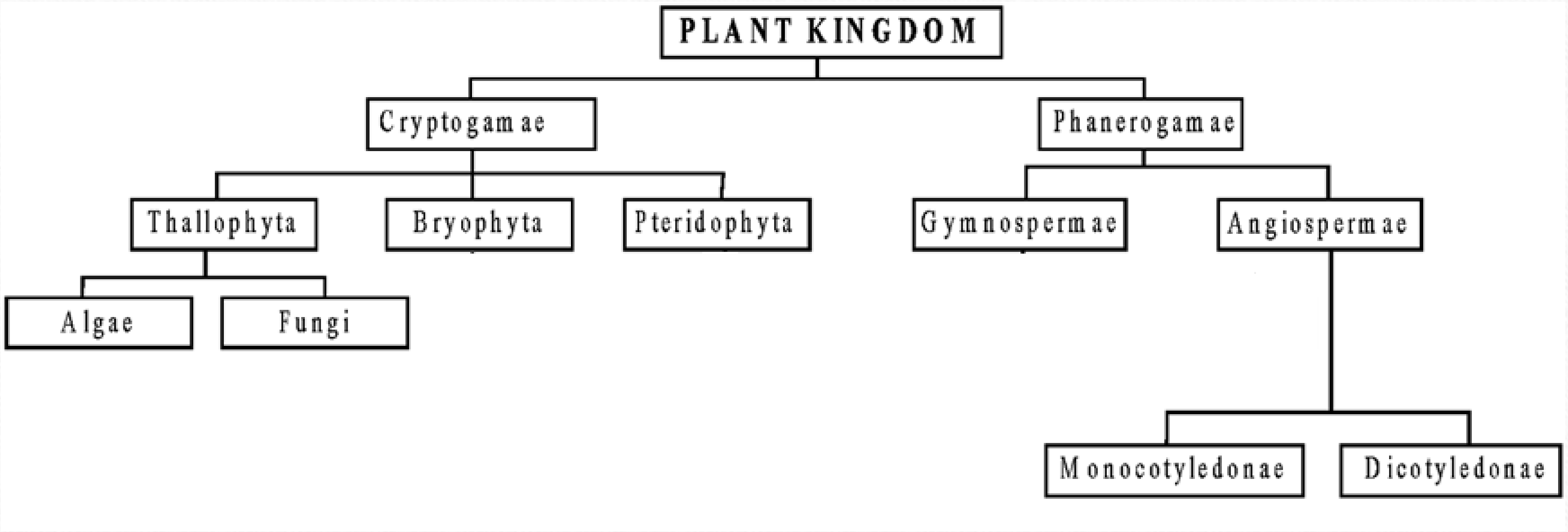
Deuteromycetes

- Imperfect fungi
- Mycelium branched, septate.
- Sexual reproduction not yet discovered.
- Mostly decomposers.
- Eg: *Alternaria, Trichoderma*





Eichler's classification – 1883



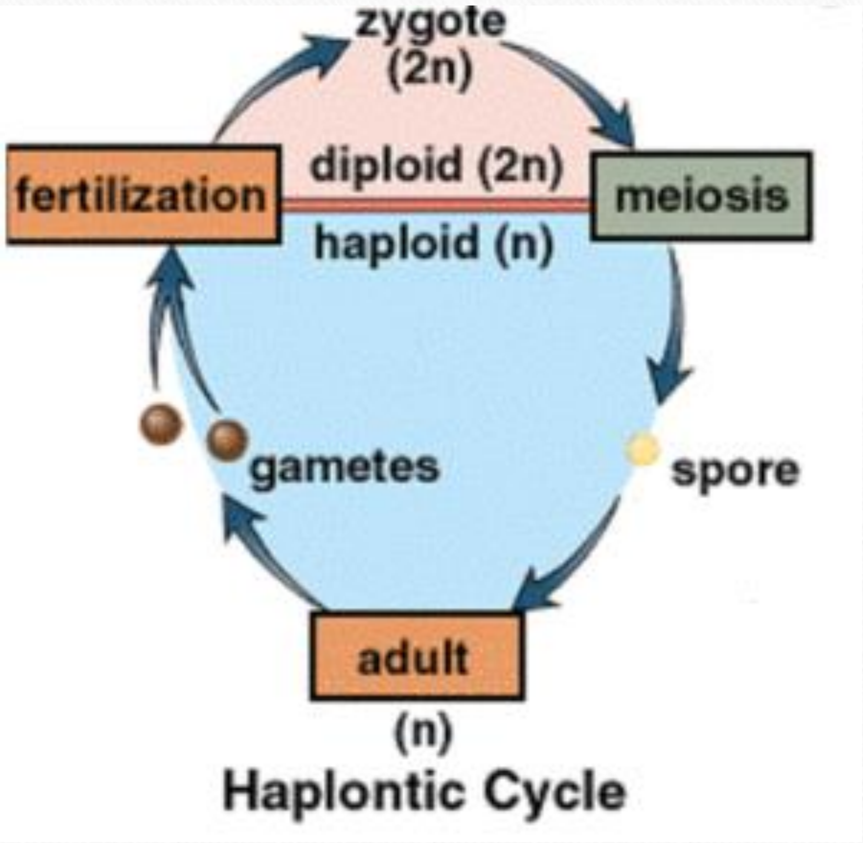
- PLANT KINGDOM
  - Cryptogamae
    - Thallophyta
      - Algae
      - Fungi
    - Bryophyta
    - Pteridophyta
  - Phanerogamae
    - Gymnospermae
    - Angiospermae
      - Monocotyledonae
      - Dicotyledonae

- With 5 kingdom classification, fungi was removed from thallophyte (1969)
- Chl a – universal pigment
- **Lifecycle**
  - Gametophyte – haploid plant body
  - Sporophyte – diploid plant body

Thallophyta (Algae)

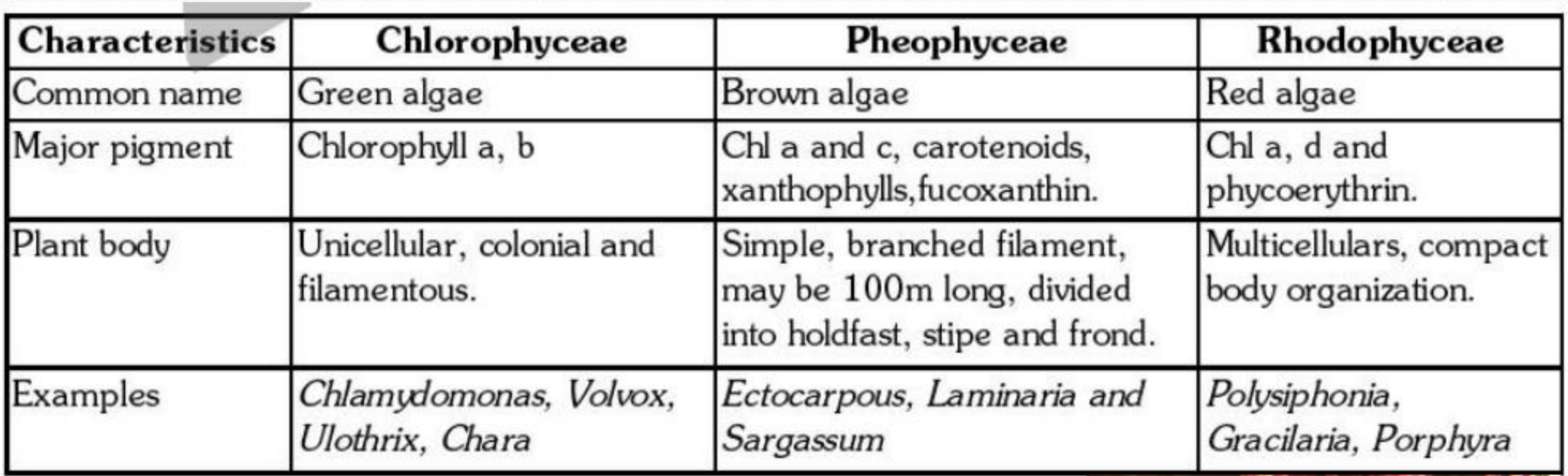
- Body thalloid, aquatic, autotrophic
- Unicellular, colonial or multicellular
- Major producers of aquatic ecosystems
- May be symbiotic – lichen; on sloth bear (*Trichophilus welckeri*)
- Reproduction : Asexual (fragmentation, spore formation), sexual
- *Hydrocolloids/Phycocolloids* extracted from certain algae are used as thickening agent or as laboratory growth media. Eg: Agar-agar, carrageenan (from red algae); algin (from brown algae)
- Some are edible. Eg: *Chlorella, Undaria pinnatifida, Ulva lactuca*, etc.
- Life cycle is haplontic

Algae Life cycle



Haplontic Cycle

Algae Classification



Characteristics	Chlorophyceae	Pheophyceae	Rhodophyceae
Common name	Green algae	Brown algae	Red algae
Major pigment	Chlorophyll a, b	Chl a and c, carotenoids, xanthophylls,fucoxanthin.	Chl a, d and phycoerythrin.
Plant body	Unicellular, colonial and filamentous.	Simple, branched filament, may be 100m long, divided into holdfast, stipe and frond.	Multicellulars, compact body organization.
Examples	*Chlamydomonas, Volvox, Ulothrix, Chara*	*Ectocarpous, Laminaria and Sargassum*	*Polysiphonia, Gracilaria, Porphyra*

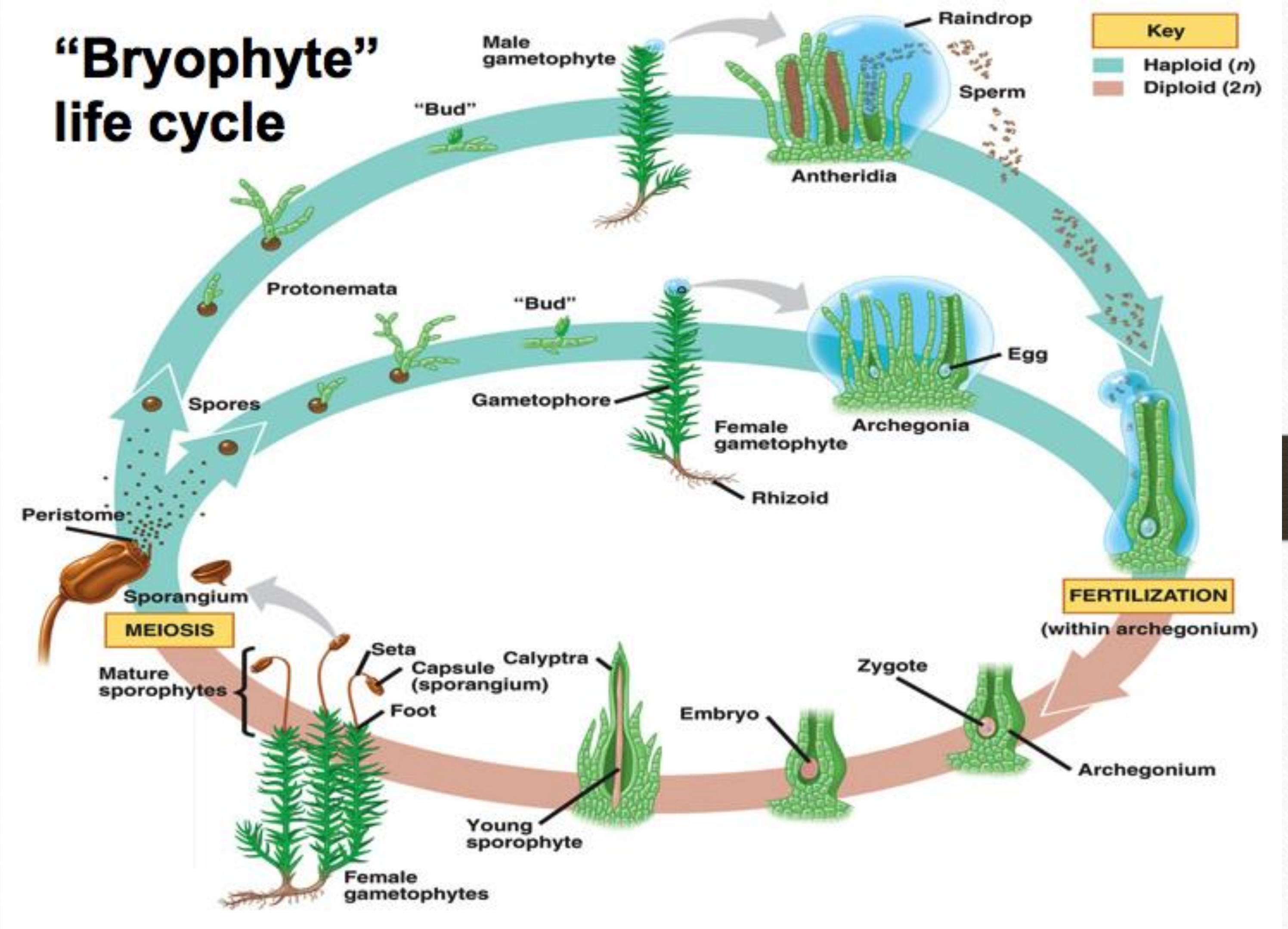
Sargassum

Chara

Gracilaria

Bryophyta

- Main plant body developed stems and leaves, true roots absent, root-like **rhizoids** present
- First land plants (not successful due to *absence of vascular tissue*), need water for fertilization – Amphibians of plant kingdom - **Sciophytes**
- Main plant body is haploid. Sporophyte grows on gametophyte, i.e., **sporophyte is dependent on gametophyte – Alternation of generation**
- **Gametophyte produces gametes** in **archegonia (female)** and **antheridia (male) sex organs.** (Egg and antherozoids)
- Life cycle is **haplodiplontic**



Bryophyta

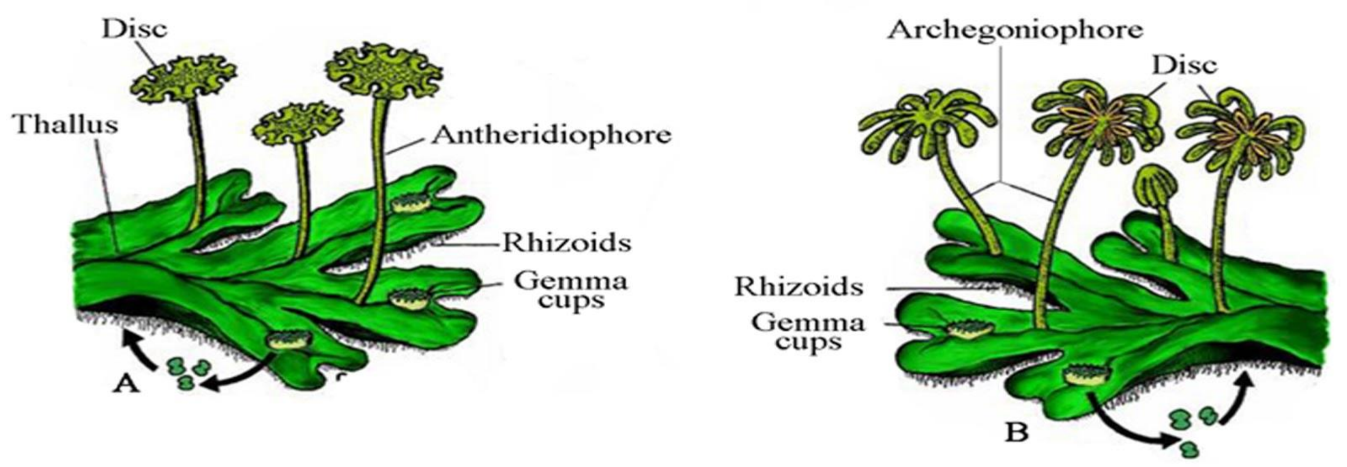
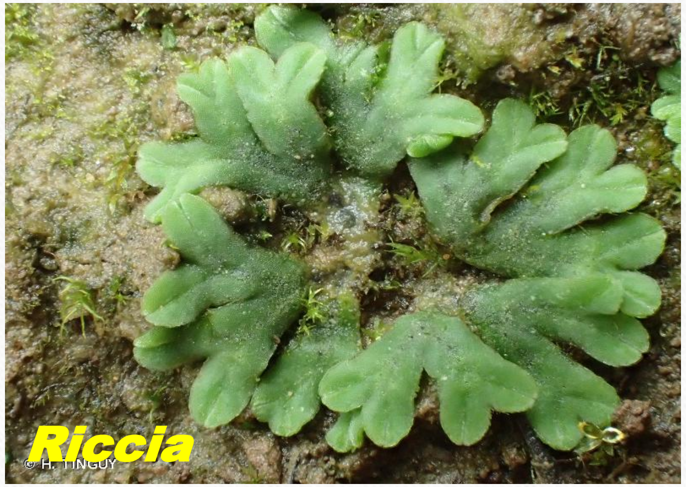
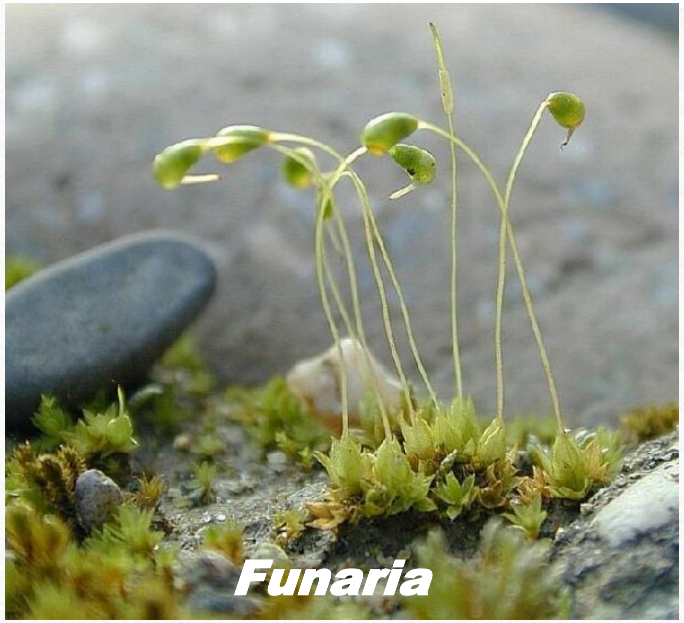
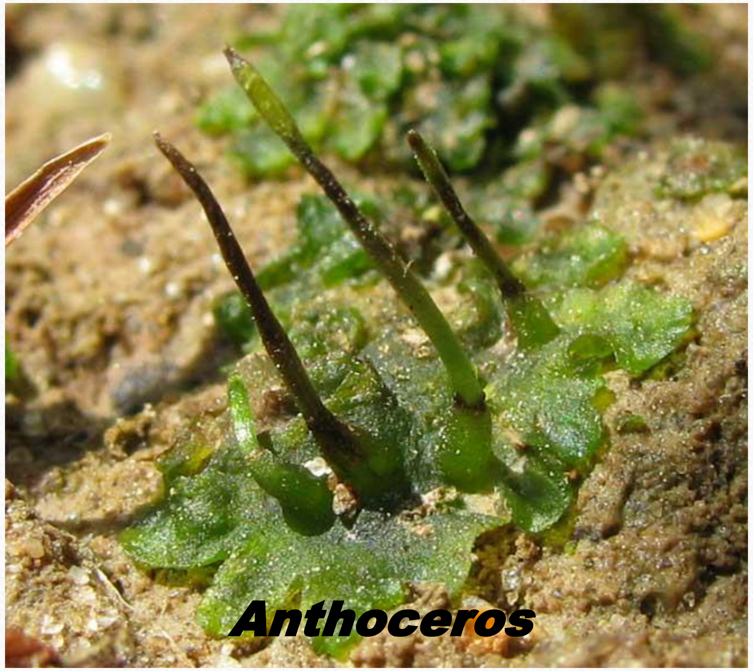


Fig: *Marchantia spp.* (A) Male plant, (B) Female plant.

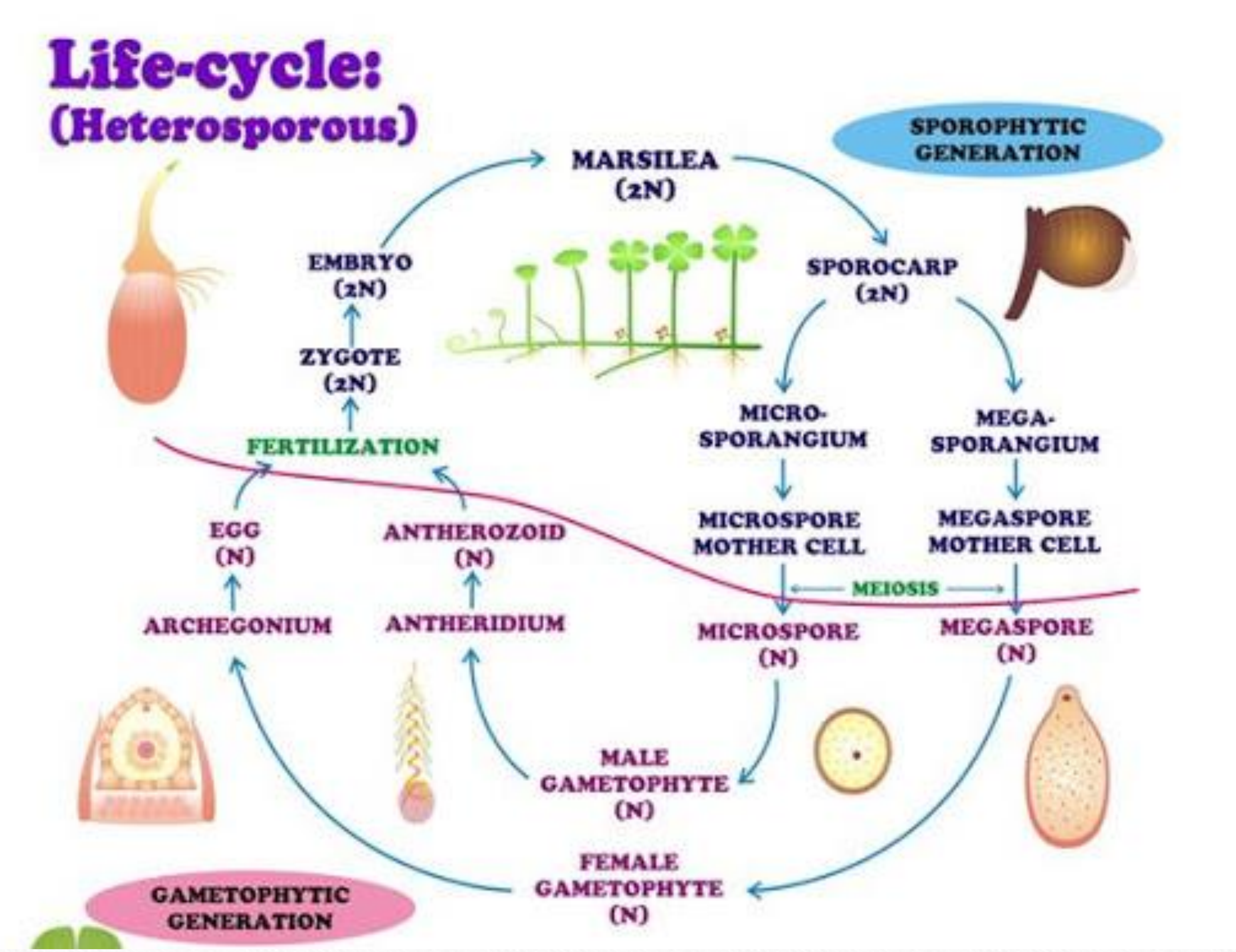


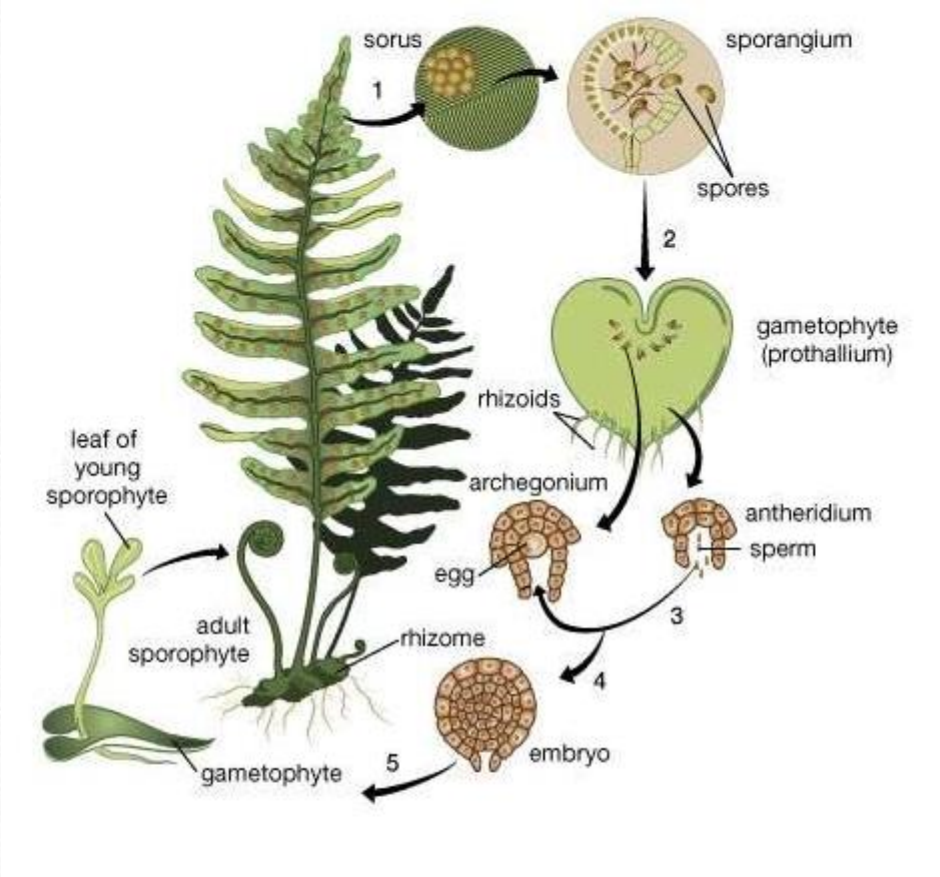


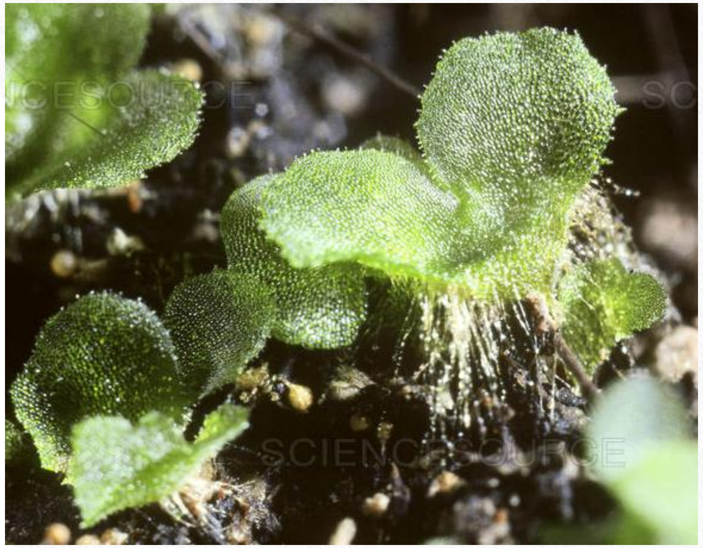


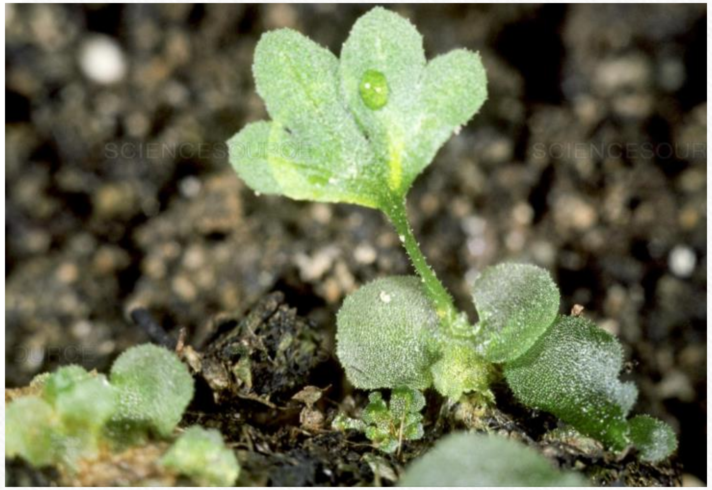
Pteridophyta

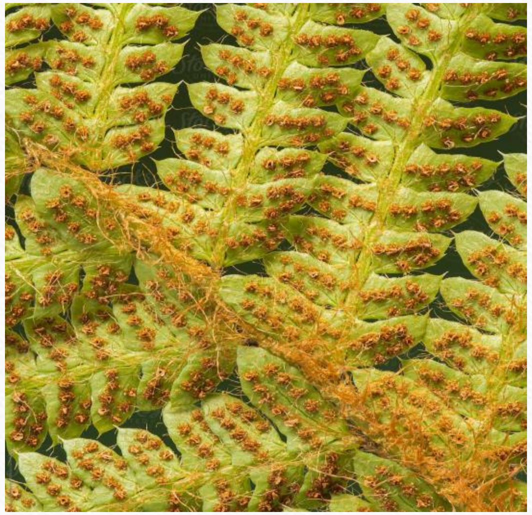
- Main plant body divided into stem, leaves, and true roots.
- Leaf types – Sporophylls (spore bearing), and tropophylls (only photosynthetic.
- Sporophylls may be compacted into **strobilus/cone**. Eg. *Selaginella, Equisetum*
- First **successful** land plants, still need water for fertilization – Reptiles of plant kingdom – **have vascular tissue.**
- **Vascular cryptogams –** xylem lacks vessels, phloem lacks sieve tubes and companion cells (have sieve cells).
- Main plant body is diploid. Sporophyte is independent on gametophyte – **Alternation of generation**
- **Sporophyte produces spores by meiosis**
- **Heterospory** develops in some species. Eg; *Azolla, Marsilea, Selaginella*
- Life cycle is **diplohaplontic**

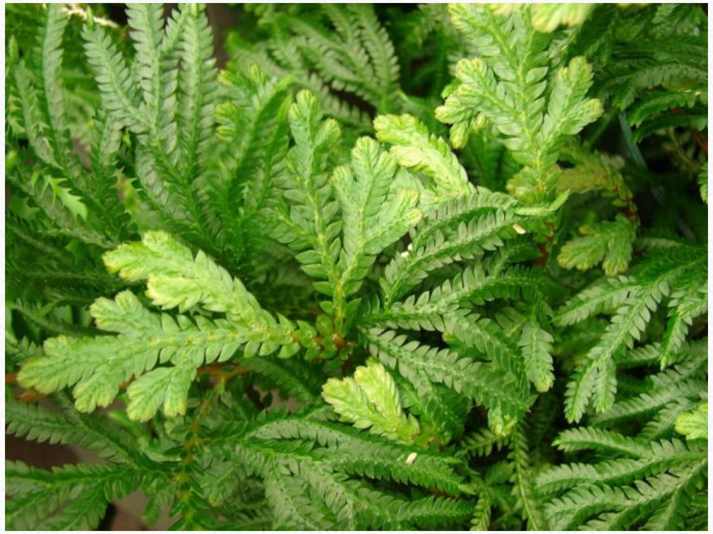



sorus
1
sporangium
spores
2
gametophyte
(prothallium)
rhizoids
leaf of
young
sporophyte
archegonium
antheridium
sperm
egg
3
adult
sporophyte
rhizome
4
embryo
5
gametophyte

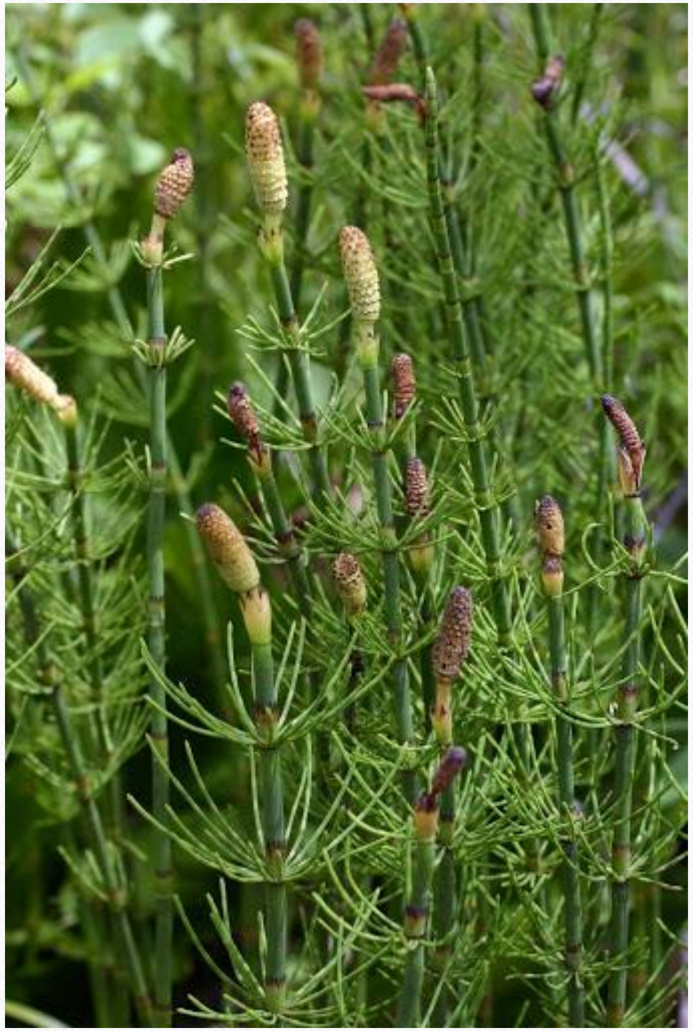








Selaginella



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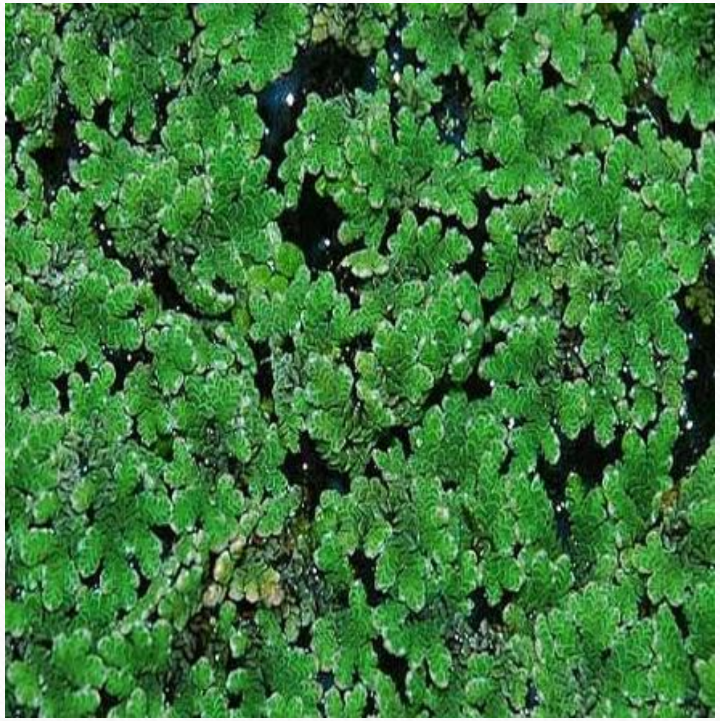

Azolla